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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR PROGRAMMABLE CALIBRATION GENERATOR TEKTRONIX, TYPE CG-5011 AND PROGRAMMABLE PULSE HEAD TEKTRONIX, TYPE 015-0611-00

Headquarters Department of the Army, Washington, DC
2 March 2004

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, US Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use https://amcom2028.redstone.army.mil.

*This bulletin supersedes TB 9-6625-2274-50, dated 3 August 1992.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Programmable Calibration Generator, Tektronix, Type CG-5011 and Programmable Pulse Head, Tektronix, Type 015-0611-00. MIS-38938/1 and the manufacturer's manual were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None.

b. Time and Technique. The time required for this calibration is approximately 6 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications[1]
Programmable Calibration Generator, Tektronix, Type CG-5011	
Amplitude calibrator: Dc and squarewave (chopped dc)	Range: 40 μV p-p to 200 V p-p into 1M Ω[2] 40 μV p-p to 5 V p-p into 50 Ω Accuracy: ±(.25% of reading +1 μV) Variable range: ±9.9% Frequency: 10 Hz, 100 Hz, 1 kHz, and 10 kHz
Current amplitude mode	Range: 1 to 100 mA Accuracy: ±(.25% of reading +2 μA) Frequency: 10 Hz, 100 Hz, 1 kHz, and 10 kHz
Edge amplitude mode	Range: Low amplitude output into 50 Ω, 20 mV p-p to 1 V p-p Risetime: ≤1.3 ns Leading edge aberrations: ±2% of square wave V p-p amplitude Long term flatness: Droop and tilt ±0.5% maximum of pulse amplitude after first 100 ns from leading edge 50% amplitude point Frequency: 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz
	Range: High amplitude output into 1 M Ω, 1 V p-p to 100 V p-p3 Risetime: ≤100 ns Leading edge aberrations: ±2%. of square wave V p-p amplitude Long term flatness: Droop and tilt ±0.5% maximum of pulse amplitude after first 500 ns from leading edge 50% amplitude point Frequency: 10 Hz, 100 Hz, 1 kHz, 10 kHz, and 100 kHz Variable amplitude: ≤±9.9% from nominal
Timing markers mode	Range: .5 ns to 5 s Accuracy: ±(.005% of reading +10 ps) Amplitude: 5 s to 2 ns ≥l V p-p into 50 Ω 1 ns ≥350 mV p-p into 50 Ω .5 ns ≥100 mV p-p into 50 Ω Variable marker: ±9.9% of marker setting
Trigger output	Trigger amplitude: 1 V minimum into 50 Ω Trigger NORMAL rate: 5 s to 100 ns; remains at 100 ns for faster rates Trigger mode RATE10: Divides NORMAL rate by 10 Trigger mode RATE 100: Divides NORMAL rate by 100
Programmable Pulse Head, Tektronix, Type 015-0611-00	
Fast edge amplitude mode	Range: ±1. 1 V ±5% into 50 Ω Risetime: <150 ps Leading edge aberrations: 3% pulse amplitude; not to exceed 40%, p-p for adjacent peaks Frequency: 100 Hz, 1 kHz, 10 kHz, and 100 kHz Variable range: >±l0%

[1]Specifications are IAW MIS-35947 and may not agree with manufacturer's stated accuracies.

[2]200 V p-p check not verified due to standards limitation.

[3]100 V p-p check not verified due to standards limitation.

[4]Long term flatness not verified due to standards limitation.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Reference Calibration Standards Set NSN 4931-00-621-7878. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories issued as indicated in paragraph **4** above and are not listed in this calibration procedure. The following peculiar accessory is also required for this calibration: Three flexible extender cables supplied with TI and a locally procured 20 k Ω, 2 W, 5 percent resistor.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
DIGITIZING OSCILLOSCOPE	Range: 1.045 to 1.155 V Frequency: 100 kHz Accuracy: ±1.25% Risetime: ≤37.5 ps (≤45 ps) Measurement capabilities: Amplitude: Range: .5 ns ≥200 mV p-p 1 ns ≥350 mV p-p 2 ns ≥1 V p-p Aberrations: ±20% of square wave amplitude to dc amplitude within ±2.5 minor divisions	Hewlett-Packard, Model 54121T (54121T)
FREQUENCY COUNTER	Period: 99.985 ns to 5.00025 s Frequency: 4999.75 to 5000.25 kHz Accuracy: ±0.00125% Frequency: 19.995 MHz to 2.04092 GHz Accuracy: 0.00625%	Fluke PM6681/656 (PM6681/656)
LEVELED SINE WAVE GENERATOR	Frequency: 10 kHz Amplitude: 1 V	Tektronix, Type SG5030 (SG5030)
MULTIMETER	Dc voltage: Range: -200.5 to +239 V dc Accuracy: ±0.0625% Dc current: Range: 5 to 100 mA Accuracy: ±-0.0625%	Hewlett-Packard, Model 3458A (3458A)
OSCILLOSCOPE	Measurement capability: Risetime: ≤10 ns 5 ns to 5 s amplitudes: ≥1 V into 50Ω	Tektronix, Type 2465B-46 (2465B-46)
TUNNEL DIODE PULSER	Input: 60 V, 100 kHz Aberrations: ≤1%	Ballantine, Model 61252A (61252A)

SECTION III
CALIBRATION PROCESS FOR
PROGRAMMABLE CALIBRATION GENERATOR
TEKTRONIX, TYPE CG-5011

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

d. When indications specified in paragraphs **8** through **13** are not within tolerance, perform Section IV, Adjustment Process for Programmable Calibration Generator, Tektronix, Type CG-5011. After completing Section IV, repeat paragraphs **8** through **13**. Do not perform if all other parameters are within tolerance.

e. Unless otherwise specified, all controls and control settings refer to the TI.

f. Unless otherwise specified, all connections referring to **OUTPUT** are made through the output cable supplied with the TI.

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Connect TI to a 115 V ac source.

b. Energize TI and allow at least 20 minutes for warm-up and stabilization.

8. Amplitude Calibrator

a. Performance Check

(1) Connect TI **OUTPUT** to multimeter voltage input. Set multimeter to measure autorange DCV.

(2) Press pushbuttons as listed in (a) through (e) below:

(a) **AMPLITUDE MODE AMPL MODE VOLT.**
(b) **AMPLITUDE MODE FREQ ⇧⇩** to highlight **+DC.**

(c) **OUTPUT USE FOR 5O Ω LOAD** off.
(d) **VARIABLE ON** off.
(e) **OUTPUT ON** on.

(3) Adjust **UNITS/DIV** dial to **20 V/D** on display and press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X l0 DIV**. Multimeter will indicate between +199.50 and +200.50 V dc.

(4) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **-DC.** Multimeter will indicate between -199.50 and -200.50 V dc.

(5) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+DC** and repeat technique of (3) and (4) above for TI settings listed in table 3.

Table 3. Amplitude Calibrator

Test instrument		Multimeter indications (±V dc)	
UNITS/DIV dial display settings (V/D)	**NUMBER OF DIV (MULTIPLIER)** pushbutton display settings (DIV)	Min	Max
10	10	99.75 V	100.25 V
10	2	19.95 V	20.05 V
10	1	9.975 V	10.025 V
1	8	7.98 V	8.02 V
1	6	5.985 V	6.015 V
1	5	4.9875 V	5.0125 V
1	4	3.99 V	4.01 V
1	3	2.9925 V	3.0075 V
.5	5	2.4938 V	2.5062 V
.5	3	1.4963 V	1.5037 V
.1	1	99.75 mV	100.25 mV

(6) Position controls as listed in (a) through (d) below:

(a) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **-DC**.
(b) Press **AMPLITUDE MODE NUMBER OF DIV ⇧⇩** pushbutton to display **X1 DIV.**
(c) Press **VARIABLE ON** pushbutton on.
(d) Adjust **UNITS/DIV** dial to display **10 V/D.**

(7) Adjust **UNITS/DIV VAR** dial to **5.0% LOW** on display. Multimeter will indicate between -10.5000 and -10.5526 V dc.

(8) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+DC**. Multimeter will indicate between + 10.5000 and +10.5526 V dc.

(9) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **-DC** and repeat technique of (7) and (8) above for TI settings listed in table 4.

(10) Press **OUTPUT ON** pushbutton off.

Table 4. Variable Amplitude Calibrator

Test instrument **VAR** dial display settings (%)	Multimeter indications (±V dc)	
	Min	Max
9.9 LOW	11.0711	11.1265
5.0 HIGH	9.5000	9.5476
9.9 HIGH	9.0764	9.1219

(11) Connect TI **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT.** Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(12) Position controls as listed in (a) through (i) below:

(a) Press **AMPLITUDE MODE AMPL MODE VOLT** pushbutton.
(b) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **10 kHz.**
(c) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER)** pushbutton to display **X 1 DIV.**
(d) Press **VARIABLE ON** pushbutton off.
(e) Adjust **UNITS/DIV** dial to display **2 VD.**
(f) Press **OUTPUT USE FOR 5O Ω LOAD p**ushbutton on.
(g) Press **TRIGGER ON** pushbutton on.
(h) Press **TRIGGER NORM** pushbutton.
(i) Press **OUTPUT ON** pushbutton on.

(13) Acquire signal using digitizing oscilloscope and adjust sensitivity to 1 mV/D. Adjust digitizing oscilloscope offset to position top of square wave exactly on center horizontal graticule.

(14) Disconnect digitizing oscilloscope **TRIG** input. Connect leveled sine wave generator **AMPLITUDE LEVELING HEAD** to digitizing oscilloscope **TRIG.**

(15) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+DC.**

(16) Set leveled sine wave generator for an output of 1 V, 10 kHz.

(17) Digitizing oscilloscope will display a signal indicating within ±.5 major division of center horizontal graticule.

(18) Press **OUTPUT ON** pushbutton off and disconnect equipment setup.

b. Adjustments. See paragraph **6 d** above.

9. Current Amplitude Mode

a. Performance Check

(1) Connect TI **OUTPUT** to multimeter current input. Set multimeter to measure autorange DCA.

. (2) Press pushbuttons as listed in (a) through (d) below:

(a) **AMPLITUDE MODE AMPL MODE CURRENT.**
(b) **AMPLITUDE MODE FREQ ⇧⇩** to highlight **+DC.**

(c) **VARIABLE ON** off.

(d) **OUTPUT ON** on.

(3) Adjust **UNITS/DIV** dial to display 1 **mA/D.** Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 5 DIV.** Multimeter will indicate between 4.9875 and 5.0125 mA.

(4) Adjust **UNITS/DIV** dial to display **5 mA/D.** Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 4 DIV.** Multimeter will indicate between 19.95 and 20.05 mA.

(5) Press **OUTPUT ON** pushbutton off.

(6) Remove multimeter and connect TI **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT.** Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(7) Position controls as listed in (a) through (g) below:

(a) Press **AMPLITUDE MODE AMPL MODE CURRENT** pushbutton.

(b) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **10 kHz.**

(c) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 4 DIV.**

(d) Press **TRIGGER ON** push-button on.

(e) Press **TRIGGER NORM** pushbutton on.

(f) Adjust **UNITS/DIV** dial to display **1 mA/D.**

(g) Press **OUTPUT ON** pushbutton on.

(8) Acquire signal using digitizing oscilloscope and adjust sensitivity to 1 mV/D. Adjust digitizing oscilloscope offset to align top of square wave exactly on center horizontal graticule.

(9) Disconnect digitizing oscilloscope **TRIG** input. Connect leveled sine wave generator **AMPLITUDE LEVELING HEAD** to digitizing oscilloscope **TRIG.**

(10) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+DC.**

(11) Set leveled sine wave generator for an output of 1 V, 10 kHz.

(12) Digitizing oscilloscope will display a signal indicating within ±.5 major division of center horizontal graticule.

(13) Press **OUTPUT ON** pushbutton off and disconnect equipment setup.

b. Adjustments. See paragraph **6 d** above.

10. Low Edge Amplitude Aberrations

a. Performance Check

(1) Connect TI **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT** using tunnel diode pulser. Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(2) Position controls as listed in (a) through (f) below:

(a) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.

(b) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 6 DIV.**

(c) Press **AMPLITUDE MODE EDGE POLARITY** pushbutton.
(d) Press **AMPLITUDE MODE FREQ** ⇧⇩ pushbutton to highlight **100 kHz.**
(e) Adjust **UNITS/DIV** dial to display **10 V/D.**
(f) Press **OUTPUT ON** pushbutton on.

(3) Rotate tunnel diode pulser trigger level knob fully ccw.

(4) Set digitizing oscilloscope probe attenuation to 1 and acquire signal. Set digitizing oscilloscope sensitivity to 50 mV/D and sweep speed to 5 μs/D.

(5) Rotate tunnel diode pulser trigger level knob slowly ccw until digitizing oscilloscope displays a stable triggered level. Adjust digitizing oscilloscope offset to view entire waveform. Digitizing oscilloscope will display a positive-going pulse with an amplitude of approximately 5 divisions.

(6) Adjust digitizing oscilloscope sensitivity and offset to display a waveform of exactly 5 vertical divisions.

(7) Adjust digitizing oscilloscope sweep speed to 5 ns/D. Adjust digitizing oscilloscope delay to align leading edge of waveform on the third vertical graticule line.

(8) Set digitizing oscilloscope sensitivity to 5 mV/D. Adjust offset to align top of waveform to center horizontal graticule.

(9) Store waveform in digitizing oscilloscope memory.

(10) Press **OUTPUT ON** pushbutton off and position TI controls as listed in (a) through (d) below:

(a) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER⇧⇩** pushbutton to display **X 5 DIV.**
(b) Adjust **UNITS/DIV** dial to display **50 mV/D.**
(c) Press **AMPLITUDE MODE FREQ** ⇧⇩ to highlight **1 MHz.**
(d) Press **VARIABLE ON** pushbutton on.

(11) Remove tunnel diode pulser from TI. Connect **OUTPUT** to digitizing oscilloscope and press **OUTPUT ON** pushbutton on.

(12) Acquire signal using digitizing oscilloscope. Adjust digitizing oscilloscope offset and TI **VAR** dial for an indication of 5 divisions.

(13) Adjust digitizing oscilloscope delay to align leading edge of waveform on the third vertical graticule line.

(14) Set digitizing oscilloscope sensitivity to 5 mV/D and sweep speed to 5 ns/D. Adjust digitizing oscilloscope offset to align top of waveform to center horizontal graticule.

(15) Recall waveform in digitizing oscilloscope memory from (9) above. Adjust digitizing oscilloscope offset to align the two signals.

NOTE

Do not use digitizing oscilloscope delay or sweep speed to align the two signals. Aberration amplitudes will not be exact.

(16) Aberration amplitudes will not deviate more than 1 vertical division.

(17) Press **OUTPUT ON** pushbutton off.

b. Adjustments. See paragraph **6 d** above.

11. Low Edge Amplitude Risetime

a. Performance Check

(1) Connect TI **OUTPUT** to digitizing oscilloscope using X10 attenuator. Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(2) Position TI controls as listed in (a) through (i) below:

(a) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.
(b) Press **AMPLITUDE MODE EDGE POLARITY** ⏋ pushbutton.
(c) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER)** ⇧⇩ pushbutton to display **X 1 DIV.**
(d) Press **AMPLITUDE MODE FREQ** ⇧⇩ pushbutton to highlight **1 MHz.**
(e) Press **TRIGGER ON** pushbutton on.
(f) Press **TRIGGER NORM** pushbutton on.
(g) Adjust **UNITS/DIV** dial to display .**5 V/D.**
(h) Press **VARIABLE ON** pushbutton off.
(i) Press **OUTPUT ON** pushbutton on.

(3) Set digitizing oscilloscope probe attenuation to 10 and acquire signal. Perform risetime measurement technique. Digitizing oscilloscope will indicate a risetime measurement of ≤1.3 ns.

(4) Press **OUTPUT ON** pushbutton off and disconnect equipment setup.

b. Adjustments. See paragraph **6 d** above.

12. High Edge Amplitude Risetime and Aberrations

a. Performance Check

(1) Connect TI **OUTPUT** to digitizing oscilloscope using X10 attenuator. Connect TI **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(2) Press pushbuttons as listed in (a) through (e) below:

(a) **AMPLITUDE MODE AMPL MODE EDGE.**
(b) **AMPLITUDE MODE EDGE POLARITY** ⏋**.**
(c) **AMPLITUDE MODE FREQ** ⇧⇩ to highlight **100 kHz.**
(d) **VARIABLE ON** off.
(e) **OUTPUT ON** on.

(3) Adjust **UNIT/DIV** dial to display **2 V/D** and press **AMPLITUDE MODE NUMBER OF DIVISIONS (MULTIPLIER)** ⇧⇩ pushbutton to display **X 1 DIV.**

(4) Acquire signal using digitizing oscilloscope and perform risetime measurement technique. Digitizing oscilloscope will indicate a risetime measurement of ≤100 ns.

(5) Set digitizing oscilloscope sensitivity to 10 mV/D and sweep speed to 200 ns/D. Adjust offset until top of waveform is centered on crt graticule.

(6) Digitizing oscilloscope will indicate a waveform with an aberration of <±l division.

(7) Press TI **OUTPUT ON** pushbutton off and disconnect equipment setup.

b. Adjustments. See paragraph **6 d** above.

13. Markers Mode

a. Performance Check

(1) Connect TI **TRIGGER OUTPUT** to frequency counter **A** input using 50 Ω feedthrough termination.

(2) Position controls as listed in (a) through (c) below:

(a) Press **TIMING MODE MARKERS** pushbutton on.
(b) Adjust **UNITS/DIV** dial to display **5 s/D.**
(c) Press **TRIGGER OUTPUT ON** pushbutton on.

(3) Frequency counter will indicate between 4.99975 to 5.00025 s.

(4) Adjust **UNITS/DIV** dial to display **2 s/D.** Frequency counter will indicate between 1.9999 and 2.0001 s.

(5) Repeat technique of (4) above for TI settings listed in table 5 below. Frequency counter will indicate within limits specified.

Table 5. Markers Mode 1 s/D to 0.5 ns/D

Test instrument **UNITS/DIV** dial display indications	Frequency counter indications	
	Min	Max
1 s/D[1]	999.95 ms	1000.05 ms
.5 s/D	499.975 ms	500.025 ms
.2 s/D	199.99 ms	200.01 ms
.1 s/D	99.995 ms	100.005 ms
50 ms/D	49.9975 ms	50.0025 ms
20 ms/D	19.999 ms	20.001 ms
10 ms/D	9.9995 ms	10.0005 ms
5 ms/D	4.99975 ms	5.00025 ms
2 ms/D	1.9999 ms	2.0001 ms
1 ms/D	999.95 µs	1.00005 ms
.5 ms/D	499.975 µs	500.025 µs
.2 ms/D	199.99 µs	200.01 µs
.1 ms/D	99.995 µs	100.005 µs
50 µsD	49.9975 µs	50.0025 µs
20 µsD	19.999 µs	20.001 µs
10 µsD	9.99949 µs	10.00051 µs
5 µsD	4.99974 µs	5.00026 µs
2 µsD	1.99989 µs	2.00011 µs
1 µsD	.99994 µs	1.00006 µs
.5 µsD	499.965 ns	500.035 ns
.2 µsD	199.98 ns	200.02 ns
.1 µsD	99.985 ns	100.015 ns
50 ns/D[2]	19.995 MHz	20.005 MHz
20 ns/D	49.9725 MHz	50.0275 MHz
10 ns/D	99.895 MHz	100.105 MHz
5ns/D	199.59 MHz	200.41 MHz

Table 5. Markers Mode 1 s/D to 0.5 ns/D (con't)

Test instrument **UNITS/DIV** dial display indications	Frequency counter indications	
	Min	Max
2 ns/D[3]	497.488 MHz	502.538 MHz
1 ns/D	0.99005 GHz	1.01015 GHz
.5 ns/D	1.96069 GHz	2.04092 GHz

[1]Set frequency counter for period measurement.
[2]Set frequency counter for frequency measurement.
[3]Move counter input connection from **A** to **C.**

(6) Press **OUTPUT ON** pushbutton off and disconnect frequency counter. Connect TI **OUTPUT** to oscilloscope **CH 1** input using 50 Ω feedthrough termination. Connect **TRIGGER OUTPUT** to oscilloscope **CH 2** input using 50 Ω feedthrough termination.

(7) Position controls as listed in (a) through (c) below:

(a) **TIMING MODE MARKERS** pushbutton.
(b) Adjust **UNITS/DIV** dial to display **5 ms/D.**
(c) Press **OUTPUT ON** pushbutton on.

(8) Acquire signals using oscilloscope and adjust **CH 1** and **CH 2** amplitude to 500 mV/D.

(9) Oscilloscope will display a marker and trigger amplitude of ≥ l V. Verify markers (.5 s/D to 5 ns/D only) and triggers (.5 s/D to 100 ns/D only) fall approximately on oscilloscope vertical graticule lines.

NOTE

Trigger rate checked from 5 s to 100 ns and remains at 100 ns for faster rates.

(10) Repeat technique of (13) above for **UNITS/DIV** dial settings from 5 s/D to 5 ns/D.

(11) Press **OUTPUT ON** pushbutton off. Disconnect setup from oscilloscope and connect **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT** using XI0 attenuator. Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(12) Adjust **UNITS/DIV** dial to display **2 ns/D** and press **TRIGGER ON** and **OUTPUT ON** pushbuttons on.

(13) Set digitizing oscilloscope channel 1 probe attenuation to 10. Acquire signal using digitizing oscilloscope. Adjust digitizing oscilloscope channel 1 sensitivity to 500 mV/D and sweep speed to 2 ns/D. Digitizing oscilloscope will display a marker amplitude of ≥1 V and falling approximately on vertical graticule lines.

(14) Adjust **UNITS/DIV** dial to display **1 ns/D.**

(15) Acquire signal using digitizing oscilloscope and adjust sensitivity to 350 mV/D and sweep speed to 1 ns/D.

(16) Digitizing oscilloscope will display a marker amplitude of 1 division or greater and markers will fall on vertical graticule lines. (Adjust delay if necessary.)

(17) Adjust **UNITS/DIV** dial to display **5 ns/DIV.**

(18) Acquire signal using digitizing oscilloscope and adjust sensitivity to 100 mV/D and sweep speed to .5 ns/D.

(19) Digitizing oscilloscope will display a marker amplitude of 1 division or greater and markers will fall on vertical graticule lines.

(20) Press **OUTPUT ON** pushbutton off and remove TI connections from digitizing oscilloscope. Connect **TRIGGER OUTPUT** to oscilloscope **CH1** using 50Ω feedthrough termination.

(21) Press **TRIGGER OUTPUT** pushbutton on. Adjust **UNITS/DIV** dial to display 1 μs/D. Acquire signal and adjust oscilloscope timebase to 1μs/D.

(22) Press **TRIGGER RATE ÷ 10** pushbutton on. Oscilloscope will display a TI trigger rate decrease by a factor of 10.

(23) Press **TRIGGER RATE ÷ 100** pushbutton on. Oscilloscope will indicate a trigger rate decrease by a factor of 10.

(24) Remove **TRIGGER OUTPUT** from oscilloscope. Connect **TRIGGER OUTPUT** to frequency counter **A** input.

(25) Press **TRIGGER NORM** pushbutton on and adjust **UNITS/DIV** dial to display **10 ns/D**.

(26) Press **VARIABLE ON** pushbutton on and adjust **VAR** dial to display **9.9% SLOW.** Frequency counter will indicate between 9009.1 and 9010.9 kHz.

(27) Adjust **VAR** dial to display **9.9% FAST**. Frequency counter will indicate between 10988.9 and 10991.1 kHz.

(28) Remove **TRIGGER OUTPUT** from frequency counter.

(29) Connect **OUTPUT** to oscilloscope **CH 1** input. Press **OUTPUT ON** pushbutton on and acquire signal using oscilloscope.

(30) Adjust oscilloscope timebase to 10 ns/D and slowly turn **VAR** dial to display from **9.9% FAST** to **9.9% SLOW.** Oscilloscope marker period will vary as dial is turned.

(31) Press **OUTPUT ON** pushbutton off.

b. Adjustments. See paragraph **6 d** above.

14. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

c. Connect TI to a scope workstation controller using an IEEE-488 cable. Energize equipment.

d. Using the controller, select the oscilloscope workstation to obtain the Tektronix ScopeCal System program. Proceed to the System Maintenance Menu.

e. Select GPIB Check.

f. At Instrument Address? prompt enter the CG-5011 address.

g. At Command? prompt enter "caldate mm-dd-yy." (For mm-dd-yy, enter actual due date.)

h. At Command? prompt enter "caldate?" to verify the new caldate.

i. At Command? prompt press Enter to obtain the Instrument Address? prompt.

j. At Instrument Address? prompt, enter "exit."

k. Repeat **a** above.

SECTION IV
ADJUSTMENT PROCESS FOR
PROGRAMMABLE CALIBRATION GENERATOR
TEKTRONIX, TYPE CG-5011

15. Preliminary Instructions

a. This section should only be performed if the TI fails to meet the performance requirements of Section III, Calibration Process for Programmable Calibration Generator, Tektronix, Type CG-5011.

b. The instructions outlined in paragraphs **15** and **16** are preparatory to the adjustment process. Personnel should become familiar with the entire bulletin before beginning the calibration. After the adjustment process has been completed, repeat Section III, Calibration Process for Programmable Calibration Generator, Tektronix, Type CG-5011.

c. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

d. Unless otherwise specified, all controls and control settings refer to the TI.

16. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

WARNING

Dangerous potentials exist at several points throughout the TI. When the instrument is operated with the covers removed, do not touch exposed connections or components.

a. Remove TI top cover, both side covers, and rear panel. Connect TI to power module interface using three flexible plug-in extenders.

b. Apply power and allow at least 20 minutes for warm-up and stabilization.

17. Power Supply

a. Press **TIMING MODE MARKERS** pushbutton and adjust **UNITS/DIV** dial to display **.5 μs**.

b. Set multimeter for dc volts and autorange. Connect positive lead of multimeter to TI A4TP1410 (fig. 1) and negative lead to TI A4TP1400 (fig. 1).

c. Adjust A5Rl004 (fig. 1) for a multimeter indication of +5.15 V dc ±0.05 V (R).

d. Remove multimeter connections and connect 20k, 2W, 5% resistor to **OUTPUT**.

e. Connect multimeter positive lead to A5TP1702 (fig. 1) and negative lead to A5TP1103 (fig. 1).

f. Position controls as listed in (1) through (5)below:

(1) Press **AMPLITUDE MODE AMPL MODE VOLT** pushbutton.

(2) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+DC.**

(3) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 10 DIV.**

(4) Adjust **UNITS/DIV** dial to display **20 V/D.**

(5) Press **OUTPUT ON** pushbutton on.

g. Adjust A5R1106 (fig. 1) for a multimeter indication of +237 V dc ±2 V (R).

h. Press **OUTPUT ON** pushbutton off. Disconnect resistor from **OUTPUT**.

i. Adjust **UNITS/DlV** dial to display **lV/D** and press **AMPLITUDE MODE NUMBER OF DIV** (**MULTIPLIER**) **⇧⇩** pushbutton to display **X 1 DIV**.

j. Connect multimeter positive lead to A5TP1102 (fig. 1).

k. Adjust A5R1104 (fig. 1) for a multimeter indication of +15.00 V dc ±02 V (R).

l. Remove multimeter connections from TI.

m. Set cal/normal switch A9S1061 (fig. 1) to the cal position (down). TI display will indicate DAC 0.

n. Connect multimeter positive lead to A6TP1304 (fig. 1) and negative lead to A6TP1400 (fig. 1).

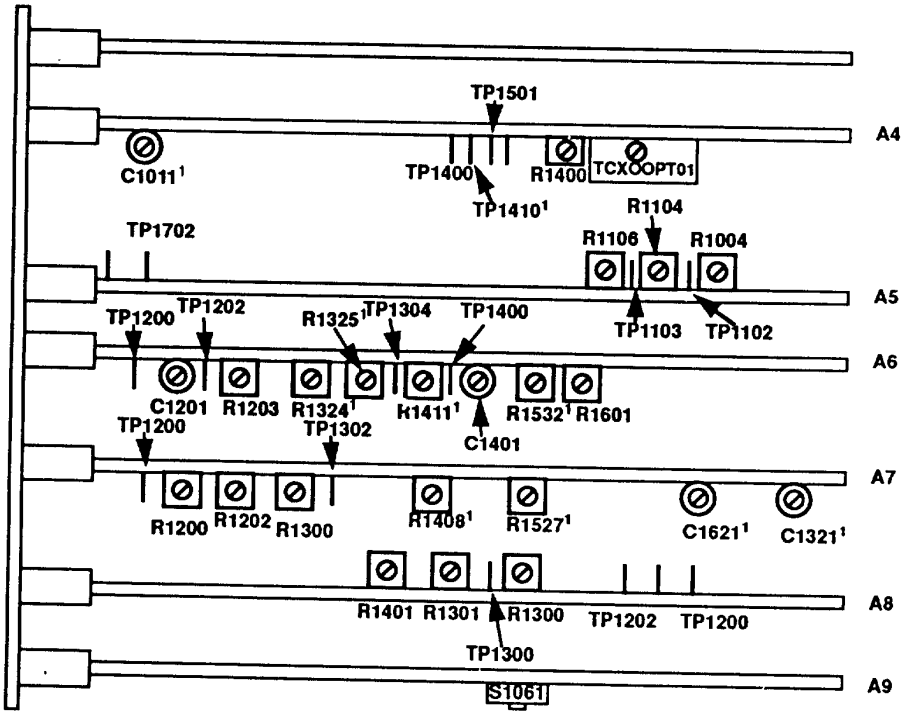
o. Adjust A6Rl325 (fig. 1) for a multimeter indication of -3.9809 V dc ±.0.0003 V.

p. Press **CONTINUE** pushbutton. Display will indicate **DAC 1**.

q. Adjust A6R1324 (fig. 1) for a multimeter indication of -6.7114 V dc ±0.001 V.

r. Connect multimeter positive lead A7TP1200 (fig. 1) and negative lead to A7TP1302 (fig. 1).

s. Adjust A7R1202 (fig. 1) for a multimeter indication of -5.25 V dc ±0.05 V.



[1]Indicates test point or adjustments are located below top edge of board.

Figure 1. Test point and adjustment locations.

t. Press **CONTINUE** pushbutton. TI display will indicate **HEAD**.

u. Adjust A7R1300 (fig. 1) for a multimeter indication of +5.25 V dc ±0.05V.

v. Remove multimeter connections. Press **CONTINUE** pushbutton. Display will indicate **DELY**.

w. Connect **TRIGGER OUTPUT** to oscilloscope **CH 1**. Connect A7TP1200 (fig. 1) to oscilloscope CH 2 using X10 probe. Acquire signal using oscilloscope. Set oscilloscope trigger to CH 1 and positive slope. Set oscilloscope to measure delay between the two signals.

x. Adjust A7R1200 (fig. 1) until oscilloscope indicates a delay of 120 ns ±10 ns at the 50 percent amplitude points between the trigger positive edge and the pulse drive negative edge waveforms.

y. Remove oscilloscope connections from TI.

z. Leave cal/normal switch A9S1061 (fig. 1) in the down position and continue with next adjustment check.

18. Calibration Factors

a. Connect **OUTPUT** to multimeter using 50 Ω feedthrough termination.

b. Press **CONTINUE** pushbutton to display **5 V * 1 X 1**. Multimeter will indicate between 4.9963 and 5.0038 V dc. If multimeter does not indicate within limits specified, adjust VAR dial until multimeter indicates within limits specified and as close to the nominal value as possible.

c. Press **CONTINUE** pushbutton and repeat technique of **b** above for settings listed in table 6. Multimeter will indicate within limits specified.

d. When display indicates **CAL DONE**, set cal/normal switch A9S1061 (fig. 1) to the normal position (up).

e. Remove multimeter connections.

Table 6. Calibration Factor Adjustments

Test instrument indications	Nominal value	Multimeter indications	
		Min	Max
50 mV * 2 X 1	50.000 mV	49.963 mV dc	50.038 mV dc
50 mV * 3 X 1	50.000 mV	49.963 mV dc	50.038 mV dc
0.1 V * 4 X 1	-100.000 mV	-99.925 mV dc	-100.075 mV dc
5 V * 5 X 1	-5.0000 V	-4.9963 V dc	-5.0038 V dc
1 V * 6 X 1	-1.0000 V	-0.99925 V dc	-1.00075 V dc
1 V * 7 X 1	1.0000 V	0.99925 V dc	1.00075 V dc
10 mA * 8 X 10	5.0000 V	4.9963 V dc	5.0038 V dc
50 mV * 9 X 11	50.000 mV	49.963 mV dc	50.0038 mV dc
50 mV * 10 X1	50.000 mV	49.963 mV dc	50.0038 mV dc
10 V * 11 X1	-10.000 V	-9.9925 V dc	-10.0075 V dc
10 V * 12 X10	-100.000 V	-99.925 V dc	-100.075 V dc
0.1 V * 13 X1	-100.000 mV	-99.925 mV dc	100.075 mV dc
2 V * 14 X6	-12.000 V	-11.991 V dc	-12.009 V dc
2 V * 15 X1	-5.000 V	-4.9963 V dc	-5.0038 V dc
50 V * 16 X2	-100.000 V	-99.925 V dc	-100.075 V dc
CAL DONE			

[1]Remove 50Ω feedthrough termination.

19. Offset

a. Position controls as listed in (1) through (4) below:

(1) Press **AMPLITUDE MODE AMPL MODE VOLT** pushbutton.

(2) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+ DC**.

(3) Press **AMPLITUDE MODE NUMBER OF DIV ⇧⇩** pushbutton display **X 1 DIV.**

(4) Adjust **UNITS/DIV** dial to display **10 V/D**.

b. Connect multimeter positive lead to A6TP1200 (fig. 1) and negative lead to A6TP1202 (fig. 1).

c. Adjust A6R1532 (fig. l) for a multimeter indication of 10.0000 V dc ±0.0010 V (R).

d. Remove multimeter connections. Connect multimeter to **OUTPUT**.

e. Adjust **UNITS/DIV** dial to display **.1 V/D**.

f. Press **OUTPUT ON** pushbutton on and adjust A6R1203 (fig. 1) for a multimeter indication of +100.00 mV dc ±.01 V (R).

g. Adjust **UNITS/DIV** dial to display **20 V/D**.

h. Adjust A6R1411 (fig. 1) for a multimeter indication of +20.000 V dc 0.050 V (R).

i. Press **OUTPUT ON** pushbutton off and connect 50 Ω feedthrough termination between **OUTPUT** and multimeter.

j. Position controls as listed in (1) through (6) below.

(1) Press **AMPLITUDE MODE AMPL MODE CURRENT** pushbutton.

(2) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **+ DC**.

(3) Press **AMPLITUDE MODE NUMBER OF DIV ⇧⇩** pushbutton to display **X 1 0 DIV.**

(4) Press **VARIABLE ON** pushbutton on.

(5) Adjust **UNITS/DIV** dial to display **10 mA/D**.

(6) Press **OUTPUT ON** pushbutton on.

k. Adjust TI VAR dial for a multimeter indication of +5.000 V dc ±0.005 V. Do not adjust VAR dial for the remainder of this step (R).

l. Adjust **UNITS/DIV** dial to display **1 mA/D** and press **AMPLITUDE MODE NUMBER OF DIV** (**MULTIPLIER**) **⇧⇩** pushbutton to display **X 1 DIV**. Adjust A6R1601 (fig. 1) for a multimeter indication of +50.000 mV dc ±0.025 V (R).

m. Press **OUTPUT ON** pushbutton off and remove 50 Ω feedthrough termination and multimeter connections from TI.

n. Connect **OUTPUT** to oscilloscope **CH 1**.

o. Position controls as listed in (1) through (7) below:

(1) Press **AMPLITUDE MODE AMPL MODE VOLT** pushbutton.

(2) Adjust **UNITS/DIV** dial to display **1 V/D**.

(3) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **100 kHz.**

(4) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 1 DIV.**

(5) Press **VARIABLE ON** pushbutton off.

(6) Press **TRIGGER ON** pushbutton on.

(7) Press **OUTPUT ON** pushbutton on.

p. Acquire signal and adjust oscilloscope amplitude to 20 mV/D and time to 0.5 μs/D. Adjust oscilloscope for a stable display with the rising edge of the signal on first vertical graticule.

q. Adjust A6C1201 (fig. 1) until oscilloscope displays a positive pulse indicating an optimum leading edge corner and a flat top.

r. Press **OUTPUT ON** pushbutton off and remove oscilloscope connections. Connect multimeter positive lead to A8TP1202 (fig. 1) and negative lead to A8TP1200 (fig. 1).

s. Adjust A8Rl300 (fig. l) for a multimeter indication of +2.73 V dc ±0.03 V.

t. Remove multimeter positive lead and connect to A8TP1300 (fig. 1). Adjust A8Rl301 (fig. 1) for a multimeter indication of 0.000 V dc ±.003 V.

u. Press **OUTPUT ON** pushbutton off. Remove multimeter connections.

20. Low Edge Risetime

a. Connect **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT** using X10 attenuator. Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG**.

b. Position controls as listed in (1) through (9) below:

(1) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.

(2) Press **AMPLITUDE MODE EDGE POLARITY** ⏋ pushbutton.

(3) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **1 MHz.**

(4) Press **AMPLITUDE MODE NUMBER OF DIV(MULTIPLIER) ⇧⇩** pushbutton to display **X 1 DIV.**

(5) Press **TRIGGER ON** pushbutton on.

(6) Press **TRIGGER NORM** pushbutton on.

(7) Adjust **UNITS/DIV** dial to display **1 V/D.**

(8) Press **VARIABLE ON** pushbutton off.

(9) Press **OUTPUT ON** pushbutton on.

c. Acquire signal. Set digitizing oscilloscope probe attenuation to 10 and set sweep speed to 2 ns/D.

d. Perform risetime measurement technique using digitizing oscilloscope. Adjust A7C1621 (fig. 1) until digitizing oscilloscope indicates a risetime less than 1.3 ns and minimum aberrations (R).

e. Press **OUTPUT ON** pushbutton off and remove digitizing oscilloscope connections.

21. Mid and High Edge Offset

a. Connect TI output to oscilloscope **CH1**.

b. Position controls as listed in (l) through (7) below:

(1) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.

(2) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **1 kHz.**

(3) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 8 DIV.**

(4) Press **AMPLITUDE MODE EDGE POLARITY** pushbutton.

(5) Press **VARIABLE ON** pushbutton off.

(6) Adjust **UNITS/DIV** dial to display **2 V/D.**

(7) Press **OUTPUT ON** pushbutton on.

c. Acquire signal and set oscilloscope amplitude to 2 V/D. Adjust oscilloscope variable control for exactly 6 vertical divisions of trace separation.

d. Position controls as listed in (1) through (6) below:

(1) Press **AMPLITUDE MODE AMPL MODE VOLT** pushbutton.

(2) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 8 DIV.**

(3) Press **AMPLITUDE MODE FREQ ⇧⇩** to highlight **1 kHz**.

(4) Press **VARIABLE ON** pushbutton on.

(5) Adjust **UNITS/DIV** dial to display **2 V/D**.

(6) Press **OUTPUT ON** pushbutton on.

e. Adjust TI **VAR** dial until oscilloscope indicates exactly 6 divisions of trace separation. Do not change once set.

f. Adjust **UNITS/DlV** dial to display **.2V/D** and press **AMPLITUDE MODE NUMBER OF DIV** (**MULTIPLIER**) **⇧⇩** pushbutton to display **X 6 DIV**.

g. Set oscilloscope amplitude to 200 mV/D and adjust variable control until display indicates exactly 5 vertical divisions of trace separation.

h. Position controls as listed in (1) through (4) below:

(1) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.

(2) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 6 DIV.**

(3) Adjust **UNITS/DIV** dial to display **.2 V/D**.

(4) Press **OUTPUT ON** pushbutton on.

i. Adjust A7R1408 (fig. 1) until oscilloscope displays exactly 5 vertical divisions of trace separation.

j. Adjust **UNITS/DIV** dial to display **2 V/D** and press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **100 kHz**.

k. Acquire signal using oscilloscope and set amplitude to 2 V/D. Perform risetime technique using oscilloscope.

l. Adjust A7R1527 (fig. 1) until oscilloscope displays a risetime of ≤40 ns.

m. Press **OUTPUT ON** pushbutton off and connect X10 probe between oscilloscope and TI.

n. Position controls as listed in (1) through (6) below:

(1) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.

(2) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 5 DIV.**

(3) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **1 kHz**.

(4) Adjust **UNITS/DIV** dial to display **20 V/D.**

(5) Press **VARIABLE ON** pushbutton off.

(6) Press **OUTPUT ON** pushbutton on.

o. Acquire signal using oscilloscope and set amplitude to 2 V/D. Adjust oscilloscope variable control until display indicates exactly 4 vertical divisions of trace separation.

p. Position controls as listed in (1) through (6) below:

(1) Press **AMPLITUDE MODE AMPL MODE VOLT** pushbutton.

(2) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 5 DIV.**

(3) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **1 kHz**.

(4) Adjust **UNITS/DIV** dial to display **20 V/D**.

(5) Press **VARIABLE ON** pushbutton on.

(6) Press **OUTPUT ON** pushbutton on.

q. Adjust TI **VAR** dial for exactly 4 vertical divisions of trace separation on oscilloscope. Do not change once set.

r. Adjust **UNITS/DIV** dial to display **5 V/D** and press **AMPLITUDE MODE NUMBER OF DIV** (**MULTIPLIER**) **⇧⇩** pushbutton to display **X 4 DIV**.

s. Adjust oscilloscope amplitude to 200 mV/D and adjust variable control for 6 vertical divisions of trace separation.

t. Position controls as listed in (1) through (4) below:

(1) Press **AMPLITUDE MODE AMPL MODE EDGE** pushbutton.

(2) Press **AMPLITUDE MODE NUMBER OF DIV (MULTIPLIER) ⇧⇩** pushbutton to display **X 4 DIV.**

(3) Adjust **UNITS/DIV** dial to display **5 V/D**.

(4) Press **OUTPUT ON** pushbutton on.

u. Adjust A8R140l (fig. 1) until oscilloscope displays exactly 6 vertical divisions of trace separation.

v. Press **OUTPUT ON** pushbutton off and remove oscilloscope connections.

22. Time Markers

a. Press **TIMING MODE MARKERS** pushbutton.

b. Connect multimeter positive lead to A4TP1501 (fig. 1) and negative lead to A4TP1400 (fig. 1).

c. Adjust A4R1400 (fig. l) for a multimeter indication of +12.0 V dc ±0.1 V.

d. Remove multimeter connections from TI.

e. Connect **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT** using X10 attenuator. Connect TRIGGER OUTPUT to digitizing oscilloscope TRIG.

f. Position controls as listed in (1) through (7) below:

(1) Press **TIMING MODE MARKERS** pushbutton.

(2) Press **TIMING MODE MAG X10** pushbutton off.

(3) Press **VARIABLE ON** pushbutton off.

(4) Adjust **UNITS/DIV** dial to display **20 ns/D.**

(5) Press **TRIGGER ON** pushbutton on.

(6) Press **TRIGGER NORM** pushbutton on.

(7) Press **OUTPUT ON** pushbutton on.

g. Set digitizing oscilloscope probe attenuation to 10 and acquire signal. Adjust sweep speed and delay to display 2 time marker waveforms.

h. Adjust A4C1011 (fig. 1) until digitizing oscilloscope displays a triangular shaped marker amplitude indicating greater than 1.25 V peak (R).

i. Press **OUTPUT ON** pushbutton off. Remove digitizing oscilloscope connections. Connect **TRIGGER OUTPUT** to frequency counter **A** input using 50 Ω feedthrough termination.

j. Position controls as listed in (1) through (4) below.

(1) Press **TIMING MODE MARKERS** pushbutton.

(2) Adjust **UNITS/DIV** dial to display **.2μs/D.**

(3) Press **TRIGGER ON** pushbutton on.

(4) Press **TRIGGER NORM** pushbutton on.

k. Counter will indicate a display of 5000 kHz ±.25 kHz. If TI does not indicate within limits specified, continue with paragraph **m** below. If TI indicates within limits specified, continue with paragraph **n** below.

l. Remove screw covering adjustment hole on the top of TCXO OPT01 (fig. 1) case. Note the marking on the TCXO OPT01 (fig. 1) case. Adjust TCXO OPT01 (fig. 1) frequency trimmer for a frequency counter display equal to frequency marked on TCXO OPT01 (fig. 1) case (R).

m. Replace screw covering adjustment hole.

n. Press **TRIGGER OUTPUT ON** pushbutton off and disconnect equipment setup.

SECTION V
CALIBRATION PROCESS FOR PROGRAMMABLE PULSE HEAD TEKTRONIX, TYPE 015-0611-00

23. Preliminary Instructions

a. The instructions outlined in paragraphs **23** and **24** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual.

d. Unless otherwise specified, all controls and control settings refer to the TI.

24. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Remove TI bottom protective cover, as required, for adjustments.

b. Connect TI to programmable calibration generator **OUTPUT**.

c. Connect programmable calibration generator to a 115 V ac source.

d. Energize programmable calibration generator and allow at least 30 minutes for warm-up and stabilization.

25. Fast Edge Pulse Amplitude Mode

a. Performance Check

(1) Connect **OUTPUT** to digitizing oscilloscope using **PULSE HEAD** and **X10** attenuator. (Use a different Xl0 attenuator if not in tolerance.) Connect **TRIGGER OUTPUT** to digitizing oscilloscope **TRIG.**

(2) Press pushbuttons as listed in (a) through (g) below:

(a) **AMPLITUDE MODE AMPL MODE FAST EDGE**.
(b) **AMPLITUDE MODE EDGE POLARITY** ⍀.
(c) **AMPLITUDE MODE FREQ** ⇧⇩ to highlight **100 kHz**.
(d) **VARIABLE ON** off.
(e) **TRIGGER ON** on.
(f) **TRIGGER NORM**.
(g) **OUTPUT ON** on.

(3) Press and hold **FAST EDGE** pushbutton until display indicates **dL.**

(4) Set digitizing oscilloscope probe attenuation to 10. Acquire signal using digitizing oscilloscope.

(5) Perform Delta V measurement technique using digitizing oscilloscope, by placing the Delta V markers on the upper and lower waveform peaks. Digitizing oscilloscope Delta V will indicate between 1.045 and 1.155 V. Record Delta V indication.

(6) Press **VARIABLE ON** pushbutton on. Turn **VAR** dial (min/max) to vary pulse amplitude indication on digitizing oscilloscope.

(7) Digitizing oscilloscope will indicate a pulse amplitude indication at least ±l0 percent of pulse amplitude recorded in (5) above.

(8) Press **VARIABLE ON** pushbutton off.

(9) Maintain setup and continue with next performance check.

b. Adjustments. No adjustments can be made.

26. Fast Edge Pulse Risetime

a. Performance Check

(1) Acquire signal using digitizing oscilloscope.

(2) Perform risetime measurement technique using digitizing oscilloscope. Digitizing oscilloscope will indicate a risetime measurement of ≤150 ps/D.

(3) Maintain setup and continue with next performance check.

b. Adjustments. No adjustments can be made.

27. Fast Edge Leading Edge Aberrations

NOTE

If any of the following aberration performance checks are not within the limits specified, perform **b** below.

a. Performance Check

(1) Acquire signal using digitizing oscilloscope and set sweep speed to 1 ns/D. Adjust delay to center waveform on vertical center graticule.

(2) Set digitizing oscilloscope sensitivity to 10 mV/D and adjust offset to place the top of waveform on center horizontal graticule.

(3) Adjust digitizing oscilloscope offset and delay until waveform is displayed as indicated in figure 2.

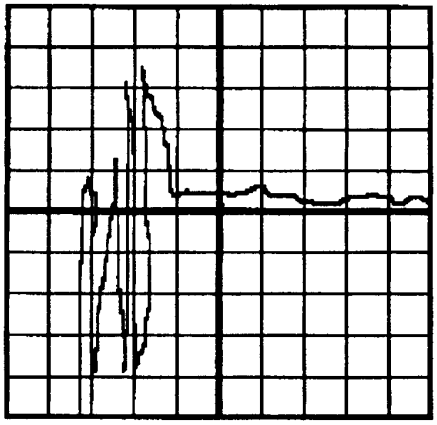


Figure 2. Aberration waveform display.

(4) Perform Delta V measurement technique, using oscilloscope, by placing one marker on the upper peak of the aberration and one marker on center graticule. Digitizing oscilloscope Delta V (peak aberrations will indicate <3 percent of amplitude recorded in **25 a** (5) above.

(5) Adjust one Delta V marker of oscilloscope to the lower peak of the aberration and one to center horizontal graticule.

(6) Digitizing oscilloscope Delta V (peak aberration) will indicate <3 percent of amplitude recorded in **25 a** (5) above.

(7) Adjust digitizing oscilloscope Delta V markers to the upper and lower aberrations.

(8) Digitizing oscilloscope Delta V (peak-to-peak aberration) will indicate <4 percent of amplitude recorded in **25 a** (5) above.

(9) Maintain setup and continue with next performance check.

b. Adjustments

(1) Press **OUTPUT ON** pushbutton off and remove **X10** attenuator. Connect **OUTPUT** to digitizing oscilloscope **INPUT/TDR OUTPUT** using **PULSE HEAD** and **X5** attenuator.

(2) Press pushbuttons as listed in (a) through (g) below:

(a) **AMPLITUDE MODE AMPL MODE FAST EDGE**.
(b) **AMPLITUDE MODE EDGE POLARITY** ⍀.
(c) **AMPLITUDE MODE FREQ** ⇧⇩ to highlight **l00 kHz**.

(d) **VARIABLE ON** off.
(e) **TRIGGER OUTPUT** on.
(f) **TRIGGER NORM** on.
(g) **OUTPUT ON** on.

(3) Press and hold **FAST EDGE** pushbutton until display indicates **dL.**

(4) Set digitizing oscilloscope probe attenuation to 5 and acquire signal using digitizing oscilloscope and set sensitivity to 10 mV/D and sweep speed to 5 ns/D.

(5) Adjust digitizing oscilloscope offset until the flattest portion of waveform is centered on horizontal center graticule.

(6) Adjust R1200 (fig. 3) for a maximum flatness on the top pulse (R).

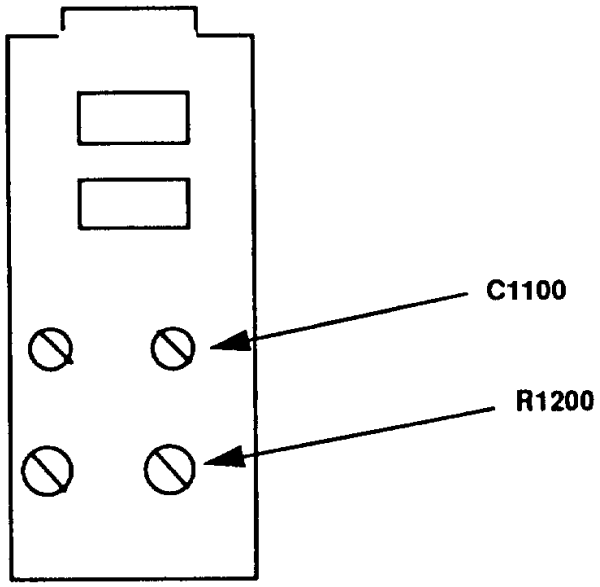


Figure 3. Pulse head fast edge leading aberration adjustment locations.

(7) Adjust C1100 (fig. 3) to equalize the aberrations on each side of horizontal graticule center line (R).

(8) Repeat (6) and (7) above as necessary until optimum displayed pulse is obtained.

(9) Digitizing oscilloscope will display a pulse indicating aberrations <±3 percent of pulse amplitude. Adjacent pulse peaks will not exceed 4 percent peak-to-peak.

(10) Press **OUTPUT ON** pushbutton off and remove all connections from TI.

(11) Repeat paragraphs **25** through **27** above.

28. Fast Edge Pulse Frequency

a. Performance Check

(1) Acquire signal using digitizing oscilloscope and set sweep speed to 1 μs/D. Digitizing oscilloscope will display a waveform cycle.

(2) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **1 kHz**.

(3) Acquire signal using digitizing oscilloscope and set sweep speed to 100 μs /D. Digitizing oscilloscope will display a waveform cycle.

(4) Press **AMPLITUDE MODE FREQ ⇧⇩** pushbutton to highlight **100 Hz** and set digitizing oscilloscope timebase to 1 ms/D.

(5) Acquire signal using digitizing oscilloscope and set sweep speed to 1 ms/D. Digitizing oscilloscope will display a waveform cycle.

(6) Press **OUTPUT ON** pushbutton off.

b. Adjustments. No adjustments can be made.

29. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

Official:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army

0400502

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500. 2 January 2003 requirements for calibration procedure TB-9-6625-2274-50.

INSTRUCTIONS FOR SUBMITTING AN ELECTRONIC 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.